Early lessons from the design of tactile terminals for elderly people

Do older people positively consider using tactile screens combined with RFID tags to manage their daily activities?

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Abstract — **This paper presents the early results of the multi-disciplinary project Tivipol aiming to propose ICT devices to enhance the daily life of older people in a retirement home. A prototype combining a tactile color screen, a RFID reader and a ticket printer has been designed. It allows the older people to manage their usual activities in the retirement home (e.g. reserving their menu for the next days). A first formative evaluation carried out with five residents of the home has shown the high level of usability and possible acceptance of the new system. This ongoing research is intended to find out which elements play a key role in the acceptation and diffusion of ICT devices among elderly people in good physical and mental conditions.**

Older people, RFID, Tactile Terminal, Field Study, Evaluation

I. INTRODUCTION

Information and communication technologies (ICT) can play very diverse roles for older people. They can help limit the consequences of sensory or cognitive impairments (e.g. [5] for people with dementia). They can support new ways to undertake social activities. They can also enhance the physical environment in order to monitor the daily life and trigger the appropriate alarms or notifications when some events or behaviors are detected (e.g. Georgia Tech's purpose-built aware home [7]). Those applications differ from several viewpoints. Despite its potential influence on the user attitude the visibility of the technology for the older people is a dimension that is less often highlighted. From this point of view, the purpose is often to hide the ICT devices (e.g. home sensors [8]) or to embed them into usual objects that are usually not related to ICT (e.g. intelligent companions [6]).

We have adopted another perspective and we focus on visible objects that are perceived as innovative ICT-related objects but not as computers. This research requires studying the design factors that favor or hinder the acceptation of these technologies by older people. This population often feels uneasy with computers and ICT technologies (cf. e.g. [6]). In many cases, this is due to the fact that those devices do not take into account the age-specific changes in sensory, motor and cognitive abilities. In addition, the basic features of the older people world are often fundamentally different from the concepts, habits and experience of the ICT professionals. This dichotomy may result in negative experiences and (justified or unjustified) mistrust in ICT technologies. To sum up our purpose is not to hide the ICT nature of some devices dedicated to older people but to adapt these objects to their needs and skills and to demystify the ICT world in their mind.

II. TECHNOLOGY AND AGEING

Gerontechnology can be defined as the scientific discipline studying the factors ensuring an optimal technological environment of all aging and old people up to a high age. Bouma and colleagues [1] point out that gerontechnology has to intervene in five domains of daily life: health and self-esteem, housing and daily living, mobility and transport, communication and information, and work and leisure with four goals for development: (1) enhancement and satisfaction, (2) prevention and engagement, (3) compensation and assistance, and (4) care support and organization.

The research described in this paper mainly aims to support daily living and self-esteem. It does not target medical support or people with severe impairments or dementia. Nevertheless even people getting older in good physical and mental conditions face complicating factor when they have to use innovative technologies. The individual characteristics of the user, the technological features of the device and the interaction process all play a role in this context (see [2] for an overview). In addition to the physical or cognitive ability to use a new device, the individual motivation is also a critical factor to take into account. Therefore the adoption process must be carefully understood at the individual but also at the larger social level. The degree of similarity and compatibility with existing knowledge and skills must also be mentioned in this context. Reducing the learning period is acknowledged as a positive element to increase the potential adoption of any new ICT technology. However, an additional challenge in gerontechnology consists in making the computer scientists aware of the specific skills of the older people. From this perspective, the dimension of control, i.e. the feeling of being able to steer the technology under question and to avoid

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negative effects is often underestimated. Finally emotion also seems to influence the adoption of a new system. However it has been observed that interfaces essentially relying on emotional interaction can be rejected by older people (e.g. [9]).

III. TIVIPOL PROJECT

The TIVIPOL research project was launched in fall 2007 with the purpose to investigate how older people accept new interactive technologies in retirement homes. It regroups computer scientists (experts in Human-Computer Interaction) and psychologists specialized in gerontology. As the project evolved the mixed nature of the project team clearly appears as an advantage. The computer scientists' temptation to design and develop some systems based on cutting edge technologies is tempered by the psychologists who insist on the specific cognitive and social features of the older people. Symmetrically the psychologists are made aware of some technological opportunities but also of the limitations of the current state of computer science.

A retirement home in Luxembourg was selected for our pilot study. This institution was chosen because its clientele mainly comprises seniors of comparable good health who live autonomously in apartments located within the same building. There are 118 residents in this home. They have no severe health related problems (i.e. health-care requirements of the residents must not exceed 12 hours per day).

IV. DESIGN RATIONALE

Our design process is built upon former research on the adoption of ICT systems. This topic has been largely studied in the management of information system (MIS) literature. While the TIVIPOL project focuses on a completely different target group (older people of a retirement home instead of managers or office workers), we took into account the results of MIS researchers. The technology acceptance model (TAM) [3] explains that the perceived usefulness and the perceived ease-of-use are major factors influencing the adoption of new ICT systems. The Unified Theory of Acceptance and Use of Technology [10] claims that performance expectancy, effort expectancy, social influence, and facilitating conditions determine the usage intention and the user behavior.

Combined with findings from the gerontology research (e.g. [2]) these elements allowed us to identify ten key design rules (KDR) for the new system: to fulfill existing real needs of the users (KDR1); to offer some advantages for the retirement home staff (KDR2); to require a very short learning phase (KDR3); to require no previous skill in computer usage (KDR4); to have a personalized user interface (KDR5); to be enjoyable to use (KDR6); to support social life (KDR7); to rely on a pleasant, reliable and robust terminal (KDR8); to be able to evolve progressively according to individual pace (KDR9); to support functional developments without extensive resources (KDR10).

These rules are intended to facilitate the final adoption of the system and make it become a success story. In fact, many of these key factors should always be taken into account. However, they are critical in our case due to the specific nature of the target population. The main goal is to persuade the older people that they are able to use efficiently an ICT-based system, providing that it has been carefully designed to take care of their own characteristics. In this context we were especially careful about the first impression given by the new system. We wanted to avoid every element that could potentially generate fear or distrust. We put the priority on simplicity and stability instead of complexity.

V. SYSTEM FEATURES

In order to identify the features that the new system should integrate, the TIVIPOL project team discussed with the manager of the retirement home. He explained that the home residents can participate to several activities organized by the home staff. For instance, they can choose their menu for the next days, visit some exhibitions in the city, go shopping by coach, or participate to arts and crafts activities. To attend these activities, the residents must register at the home entry desk or via the home staff. Note that the registrations are manually processed. In addition, there are no connections among the registrations to each activity. The home staff does not have a complete overview of the participations of a given resident.

This aspect of the residents' life was selected to be handled via innovative ICT technologies. Several reasons justify this choice. First, the system simply offers a new optional way to carry out some existing activities of the older people (cf. KDR 1). Second, a better management of the registrations can help the home staff to plan and organize the activities (cf. KDR2). At this stage of the project only the reservation of the menus is available. However, this module is generic and can be easily completed to handle others types of registrations according to the feedback of the evaluation process (cf. KDR10).

VI. SYSTEM DESCRIPTION

A. Hardware

In order to satisfy (KDR4) we have decided to use a terminal physically different from a classic computer. The (KDR8) constraint led us to contact a professional OEM manufacturer to configure a device that does not look like a research prototype. With its cooperation we configured a terminal including a tactile color screen, a RFID reader, a WIFI connection, and which is able to run Java applications and to connect to a database via Internet.

The identification of the users (i.e. how to log into the software application) is implemented via the RFID reader of the terminal and personal tags given to the home residents. The RFID technology is nowadays mature and sufficiently reliable (cf. KDR8). The tags can be attached to key rings, be embedded in a card similar to a credit card or inserted in personal objects. In addition the learning time required to use it is very short (cf. KDR3).

The interaction with the application relies on a tactile color screen. This technology is also popular for several years and is well known even by older people (cf. KDR4) because it is used in many circumstances (e.g ATM, public transportation terminals). However, the challenge in this context concerns the

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graphical design of the user interface and the navigation issues into the application (see software description).

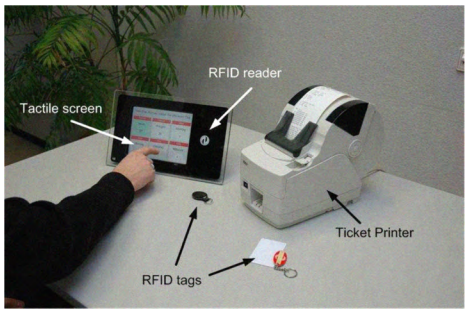

Figure 1. Components of the system

For providing to the home residents a tangible feedback of their registrations, a specific ticket printer will be placed near the terminals in the entry hall. The older people will receive a ticket for each registration. The name of the resident and the registration details are printed on the ticket (e.g. day, chosen dishes in the proposed menus). This feature plays several roles: memory aid; reassuring function to confirm that everything was correctly processed; proof of registration for the activity organizer.

B. *Software*

The first step to use the application is to log in with one's personal RFID tag. In order to keep this operation as simple as possible an animation showing how to use the RFID tag is continuously displayed on the terminal screen when it is in rest mode. This feature reminds to the users how to use the system (cf. KDR3, KDR4). Moreover the dynamic nature of the animation acts as an attractor for the people passing near the terminal (cf. KFR7).

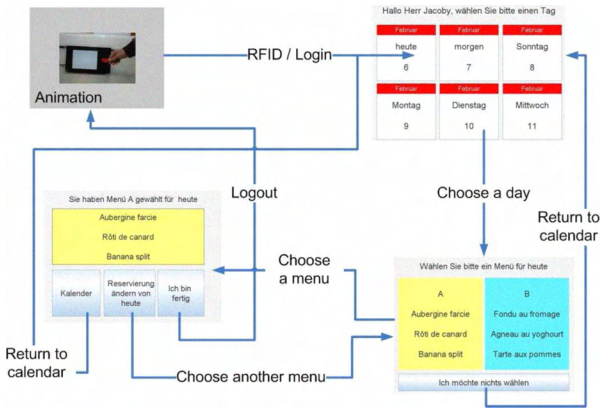

Figure 2. Navigation into the menus registration module

Once the user is connected very simple screens are displayed. The navigation has been designed to be very intuitive. (cf. Figure 2 for the registration of the menus). In addition, as far as possible, the software user interface uses some metaphors that are well known by older people (cf. KDR3). For instance, the window to select the day for the menu reservation looks like a calendar.

Many daily users of computers take it for granted to have a "*close window*" or a "*cancel*" button in every window. Nevertheless, previous research [4] has pointed out that when designing interfaces for specific categories of users (e.g. older people) it can be advantageous not to follow some legacy paradigms like WIMP (Window, Icon, Menu, Pointing device). On this basis and considering the (KDR4) factor, our application does not include menus, title bars and other similar controls. We only use few large buttons with clear visible labels. We think that the user interface must be completely designed to take into account the specific knowledge of the older people and the context of the retirement home. For example, a socially positive "*I have finished*" button advantageously replaces an impersonal "*Exit*" button.

In addition, according to (KDR5), the application is fully multi-lingual because the home residents potentially use three languages (French, German, and Luxembourgish). Just after the login the user is personally welcomed in the application in his preferred language. In the future it is also planned to communicate some personal information via the terminal.

VII. Formative Evaluation

A. *Methodology*

The complete evaluation comprises four steps. In order to get a first description of the target population, semi-structured interviews have been conducted at the initial phase of the project. In detail, social networks and social support resources have been explored. Furthermore, attitudes towards and experiences with modern technologies have been studied. A random sample of n=40 elderly people has been interviewed by trained student interviewers in two different institutions. In both cases, home managers facilitated the recruitment of the sample and further supported the project and its implementation in their institutions. Participants were on average 78.6 years old with a slight overrepresentation of women (57%) in the sample. None of the participants had a severe psycho-physical or functional condition. Results of this preliminary study showed that the elderly used in first place telephone calls for social contact and they reported in general to have little or no experiences with modern technologies such as the internet and mobile phones. On the other hand, attitude towards modern technologies in general were quite positive and accepting.

The acceptance by the end-users of the new application described in this paper (tactile terminals + RFID; ticket printer not available yet at that moment) was evaluated with a combined methodology: an observational study and an evaluative post-test interview. The sample considered here comprised 5 persons (3 women and 2 men), thereof 4 persons who already participated in the first interview-study. The participants were on average 80 years old, widowed or single, and 4 of them had no experience with computers or modern technologies. All 5 residents received standardized information on the purpose and functioning of the prototype, as well as standardized instructions (e.g. make a menu reservation for two

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days; change the chosen menu, etc.). Residents tested the new technology consecutively during a 20-minute testing phase and were subsequently interviewed about their experience. Two trained interviewers were chosen to accompany and monitor the residents in their first contact and use of the screen. Thereby, the interviewers assessed cognitive, behavioural and emotional reactions of the participants while handling the new device. Following the testing phase a semi-structured interview has been conducted covering the following aspects: appraisal of the manageability, usability and the overall acceptance of the new technology; evaluation of design-related and functional characteristics of the prototype.

B. Results

According to the observations of the two interviewers, all of the participants understood the purpose of the study from a cognitive point of view and had no difficulties in understanding the application of the new technical device. All in all, interviewers' observations indicated that participants dealt in a very confident way with the machine; none of them exhibited nervousness, timidity, concentration difficulties or disinterest. Contrariwise, the test persons made some fruitful suggestions for the further improvement of the device.

Figure 3. Formative evaluation with a home resident

Results of the subsequent interviews showed in general a good acceptance, practicability and applicability of the new device. On a 4-point Likert-scale, participants evaluated the system as "very" interesting, "quite" user-friendly, manageable, useful and potentially time-saving. They announced however some scepticism concerning the suitability of this device for all the residents in the retirement home – especially for persons showing cognitive, sensory and motor impairments.

With regard to design-related and functional characteristics the residents evaluated all the cited aspects as "very good" (in detail: font size, font colour, background colour, display size, illustration of the menu, illustration of the weekly calendar, visibility of the reservations). However, they annotated as well that the font size should be alterable for persons with amblyopia. Furthermore, they proposed that the menu selection should not be limited to the selection of either one menu one another, but rather subdivided in starters, main dishes and desserts, which would allow a more individual menu composition. Referring to the question whether they would like to use the machine in the future to reserve their weekly menus four residents agreed, whereas one was undetermined.

VIII. CONCLUSIONS AND PERSPECTIVES

This paper reports the first lessons learned from the design and the introduction of advanced ICT devices in a retirement home. Ten key factors are listed and we show how their influenced the design process of the new system. A first formative evaluation has demonstrated the potential of our approach. However further works are still needed. The initial formative evaluation described in this paper will be completed by another one at a larger scale (~20 elderly people). These results will be taken into account to update the system before a deployment for all the residents. The adoption and the effective usage of the new system will be monitored. A longitudinal study will be carried out through field observations, qualitative interviews, and system logs analysis. The usability will also be considered in this evaluation.

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REFERENCES

[1] H. Bouma, J. L. Fozard, D. G. Bouwhuis and V. Taipale. Gerontechnology in Perspective. Gerontechnology, 6(4), 2007, pp. 190-216.

[2] N. Charness and K. W. Schaie (Eds.), Impact of Technology on Successful Aging. New York: Springer, 2003, pp. 15-28.

[3] F. D. Davis. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 1989, pp. 319-340.

[4] A. Dickinson, R. Eisma and P. Gregor. Challenging Interfaces / Redesigning Users. In Proc. of CUU'03, ACM Conference on Universal Usability, November 10-11, 2003, Vancouver, British Columbia, Canada, pp. 61-68.

[5] I. Hagen, S. Cahill, E. Begley, J. Macijauskiene, J. Gilliard, K. Jones, P. Topo, K. Sarikalle, T. Holthe and P. Duff. Assessment of usefulness of assistive technologies for people with dementia. Association for the Advancement of Assistive Technology in Europe (AAATE), Lille, France, 2005.

[6] S. Kriglstein, G. Wallner, HOMIE: An Artificial Companion for Elderly People, In Proc. of ACM SIGCHI'05, ACM Conference on Human Factors in Computing Systems, April 2-7, 2005, Portland, OR, USA, pp. 2094-2098.

[7] E. Mynatt, J. Rowan, S. Craighill and A. Jacobs. Digital family portraits: Providing peace of mind for extended family members. In Proc. of ACM SIGCHI'01, ACM Conference on Human Factors in Computing Systems, March 31-April 4, 2001, Seattle, WA, USA, pp. 333-340.

[8] K. Perakis, M. Haritou, R. Stojanovic, B. Asanin, D. Koutsouris. Wireless patient monitoring for the e-Inclusion of chronic patients and elderly people. In Proc. of ACM PETRA'08, 1st International Conference on PErvasive Technologies Related to Assistive Environments, July 15-19, 2008, Athens, Greece.

[9] Sustar H. and Zaphiris P. Emotional interaction as a way of communication. In Proc. of ACM DPPI'07, International Conference on Designing Pleasurable Products and Interfaces, August 22-25, 2007, Helsinki, Finland.

[10] V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis. User acceptance of information technology: Toward a unified view., MIS Quarterly, 27(3), 2003, pp. 425-478.

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